Macalister Demonstration Farm

OPTIMUM SOIL MOISTURE FOR MAXIMUM PASTURE GROWTH

MDF Information Sheet 3
September 2009

BACKGROUND

Getting as much high quality pasture growing on your farm has always been the basis of strong dairy profitability in the MID. More recently, there has been more pressure to improve irrigation efficiency to use limited water wisely and to protect irrigated dairy's image by reducing the impact on the environment. With the fall in milk price high levels of pasture production has become critical.

As part of the Sub-surface Drip Irrigation Project soil moisture loggers were installed in the fixed spray and sub-surface drip irrigation paddocks to compare the soil moisture profile under each system. Soil moisture was monitored in each at 10 cm, 20 cm (root zone) and 40 cm (deep drainage). Pasture growth was also monitored in each.

WAS THERE A DIFFERENCE IN SOIL MOISTURE BETWEEN IRRIGATION SYSTEMS?

There was a significant difference in soil moisture patterns between the fixed spray paddock and the sub-surface drip irrigation paddock. Soil moisture data is shown in Figs 1 & 2.

To understand the graphs, the horizontal scale at the top of the graph shows the weeks from December to May. The left hand scale shows soil moisture. At the top of the graph the soil moisture is at zero kPa and the soil is waterlogged. The band between 10 and 40 kPa represents readily available water for irrigated pasture and each irrigation aims to keep soil moisture in that band. Between irrigations the soil undergoes a cycle of drying and this can be seen in the moisture level 'zig-zag' in both Fig. 1 and Fig. 2. You can see an irrigation or rain event that has taken place on the graphs every time the moisture level line moves back towards the top of the graph. The soil moisture level then falls as water is lost through the leaves of pasture grass. Sufficient water needs to be applied at each irrigation to refill the root zone. If too little water is applied then the soil moisture level may move below the optimum band and growth rates will crash .

Under fixed spray irrigation you can that soil moisture level was outside the optimum zone for most of the time between January 10th and February 10th in Fig. 1. The irrigation interval in this time was about eight days. From February 10th until about March 6th irrigation was more frequent (every 2-3 days) and the moisture level rose and was just a little too wet to be just outside the optimum. After March 6th, as the weather became a little milder, the irrigation frequency moved out to every 4 or 5 days and this was enough to keep the moisture level right in the optimum band.

Sub-surface drip irrigation delivers water directly into the root zone and with capillary action some moisture is drawn towards the surface. There is rarely water on the surface, so visually it appears too dry. However, in Fig. 2 you can see that the soil has optimum moisture for most of the time over the season, moving outside the zone only directly after irrigation when the soil became a little too wet for just a short time.

Fig 1: Soil moisture levels under fixed spray irrigation

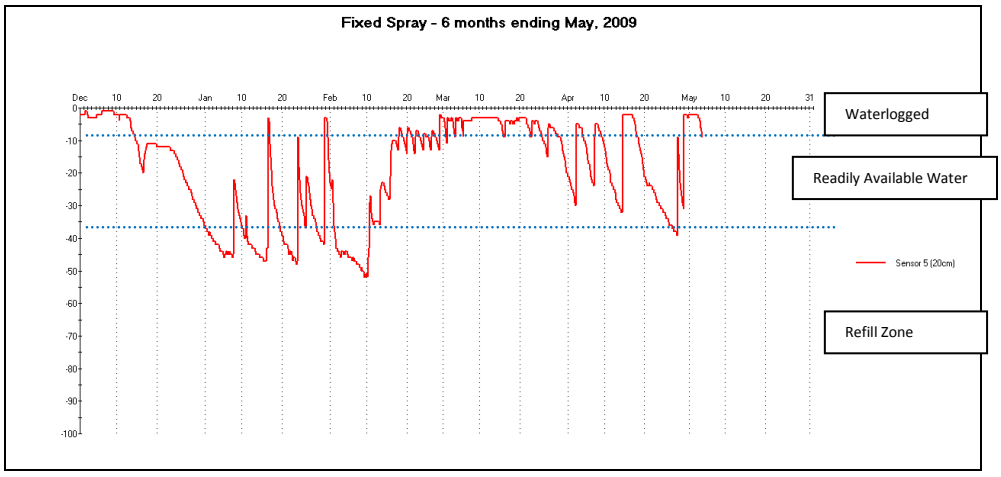
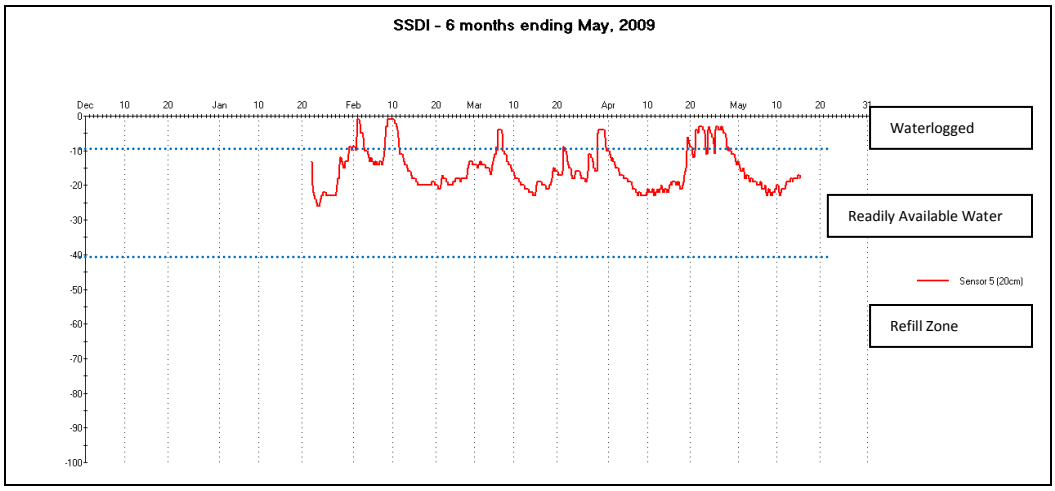


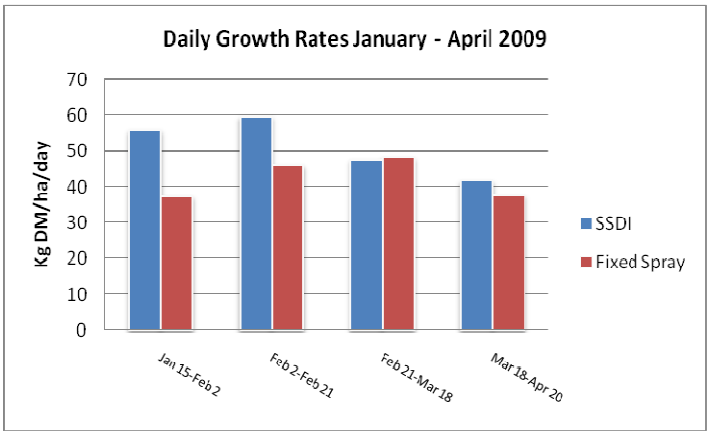
Fig 2: Soil moisture levels under sub-surface drip irrigation



HOW DOES SOIL MOISTURE AFFECT PASTURE GROWTH?

Average pasture growth rates between grazings was measured under both irrigation systems and is presented in Fig. 3. The monitoring highlighted that the pasture growth rate under sub-surface drip irrigation was much higher than under spray irrigation in January - February. When pasture growth rate is checked against soil moisture level the most significant difference is in January – February when the soil moisture under fixed spray was consistently outside the optimum zone and was too dry.

Fig. 3: Pasture growth rates under two different irrigation systems



At the same time, pasture under sub-surface drip irrigation had a consistently moist root zone and continued to grow through those months. Even on those very hot days at the beginning of February the pasture was standing tall with only limited signs of water stress.

After fixed spray irrigation was rescheduled around February 10th to water more frequently you can see its impact on soil moisture in Fig. 1. During this time the pasture growth rate under both fixed spray and sub-surface drip irrigation were much the same through February - March and April

WHAT DID WE LEARN?

Compared to average district practice the fixed spray irrigation scheduling was done pretty well even when it wasn't ideal. The high level of pasture growth rates achieved by the SSD and the later increase in growth under fixed sprays highlights the opportunity to dramatically improve pasture growth rates by maintaining ideal soil moisture.

One of the strengths of sub-surface drip irrigation design is that it delivers water right to where it is needed by the plant and, with correct irrigation scheduling, can then be maintained at an optimum level. One of the challenges of spray irrigation is to water with the right frequency and volume to maintain soil moisture in the root zone rather than stop watering when the soil surface is wet.

Regularly checking soil moisture at 20 cm depth is critical to achieving maximum growth. It is very hard to judge moisture level just by looking at the soil surface. You could monitor soil moisture level using a tensiometer or G-dots but nothing beats a shovel!

This experience suggests that just getting water to the plant when it needs it is the key, no matter what delivery system is used. If the irrigation scheduling is right and is aimed at maintaining soil moisture in the root zone then very good pasture growth can be achieved throughout the season.